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DEVELOPMENT OF HIGH FERTILITY, COST EFFECTIVE, CONTROLLED BREEDING IN SHEEP, PARTICULARLY OUT OF SEASON (SRP) TRANSITION

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ADF Project 20030469 **Dr. N. C. Rawlings**
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Final Report

Title: Development of High Fertility, Cost Effective , Controlled Breeding in Sheep, Particularly Out of Season and Prediction of Age at Puberty and Adult Fertility in the Bull by a Simple Blood Test in Young Calves.

Abstract: For industry growth, the commercial sheep flock needs to expand rapidly and we need to be able to overcome the seasonality of production. In the present one year project we applied a treatment to a large group of ewes that we think may predictably double the ovulation rate. We will look at lambing rate in June of 2004 to see if our treatment increased lamb production in commercial ewes. We also think we have a method to improve fertility to out of season breeding. This method synchronizes follicle growth in sheep (the egg bearing sac on the ovary), this year we repeated our findings to confirm this and added a treatment to ensure synchronized ovulation. We now need to move to flock scale trials. In the present project we also ran a large scale trial of a hormone test in young calves (15 to 25 weeks of age) that confirmed that we could predict the age at which bull calves are sexually mature. We will semen check these bulls at 16 months of age (July, 2004) to see if this test will predict fertility in the adult bull.

Executive Summary:

(1) Controlled Breeding Sheep.

The sheep industry in Saskatchewan is strong and growing. Sheep offer a profitable means of diversification and varied opportunities for value added production from wool, hides and meat. The commercial flock in Saskatchewan needs to increase in size and productivity and we need to remove the seasonality of breeding and production to allow orderly marketing of product. The aim of this project was to develop high fertility, cost effective methods of controlled breeding in sheep, particularly out of season. Fertility to out of season breeding is usually poor.

Our laboratory was one of 3 in North America to apply transrectal ultrasonography to the study of ovarian follicle (the ovarian egg bearing sac) growth patterns in the ewe. This allowed us to discover a simple procedure that reproducibly caused a doubling of the ovulation rate in sheep. We were also able to synchronize the growth of follicles in sheep out of season. This we think may help us to improve fertility to out of season breeding. In the present one year project, we ran a flock size trial of our method to increase ovulation rate, to see if it results in increased lambing rates; the ewes will lamb in June 2004. We were also able to repeat our method to synchronize follicle growth. In addition, in anoestrous ewes, we were able to show that the synchronized follicles will ovulate when treated with Equine Chorionic Gonadotrophin (ECG). We now need to test this method on a flock scale and look at fertility. In the present project this method of synchronizing follicle growth did not appear to work in cyclic ewes; some adjustment of treatment dose and timing maybe required for ewes during the breeding season.

(2) Predicting Age of Puberty and Fertility in Bulls.

In expanding animal agriculture in Saskatchewan, beef production will be key. The bull will play a central role in an expanding beef industry. In selection for high producing bulls, fertility tends to be sacrificed. Many young bulls are being used in Saskatchewan beef herds and a significant number are slower maturing and of questionable fertility. We have discovered a potentially simple test in young calves to predict age at maturity and hopefully fertility in the adult bull. In general, faster maturing animals are more fertile. We look at the release of a pituitary gland hormone, luteinizing hormone (LH), in response to a brain hormone called Gonadotrophin Releasing Hormone (GnRH). In the present project, we were able to confirm the usefulness of this test in a large group of bull calves (43) when applied at 15, or 25 weeks of age. The bull calves will be electroejaculated in July of 2004, to check semen characteristics and hence the ability of our test to predict fertility in the adult bull. This test could provide a useful tool to select high fertility bulls while they are still calves.

Technical Report:

1. Development of High Fertility, Cost Effective , Controlled Breeding in Sheep, Particularly Out of Season

Background and Objectives: The sheep industry in Saskatchewan is strong and growing. As Saskatchewan moves to expand animal agriculture, diversification, value added products and reliable alternative species will be essential. Sheep offer a profitable means of diversification and varied opportunities for value added production from wool, hides and meat. As an alternative livestock species sheep are low risk as their nutrition, husbandry and diseases are fairly well worked out. The commercial flock in Saskatchewan needs to increase in size and productivity and we need to remove the seasonality of breeding and production to allow orderly marketing of product. The aim of this project was to develop high fertility, cost effective methods of controlled breeding in sheep, particularly out of season. We were one of 3 laboratories in North America to develop transrectal ultrasonography for studying ovarian antral follicle growth patterns and their regulation in sheep. Ultrasonography gives us an image of the ovaries on a video screen. The follicles are the egg bearing sacs in the ovary. We have also used ovarian ultrasonography in applied studies to try to improve fertility and develop better methods for out of season breeding. Fertility to controlled breeding out of season is usually poor. With ADF-SRP support we came up with a technique to increase ovulation rate (not super ovulation) in the ewe that may allow us to increase twinning. Under this present project our aim was to test this in a larger flock of sheep. We also think we have a method to synchronize the growth of ovarian follicles that could allow us to improve fertility out of season. In the present project our aim was to repeat this and hence confirm our results, in anestrous ewes and also try it in ewes during the breeding season. In subsequent years, we hope to take both of these techniques and others we will develop, to field trials and assessment of effects on fertility.

Observations and Conclusions:

Increased Ovulation Rate in Ewes: In previous studies, in an effort to improve the fertility and success of controlled breeding in cyclic commercial ewes, we treated ewes on day 8 of a cycle with Prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$; 15mg, 1M). $PGF_{2\alpha}$ is often used in cattle to synchronize oestrus, by destroying the corpus luteum in the ovary; a structure that produces the hormone progesterone. On day 8 we also put intra-vaginal sponges in the ewes; these sponges are often used to synchronize

estrus in sheep and they release a progesterone like hormone. (Medroxy progesterone acetate; MAP). Sponges were removed after 6 days. This treatment resulted in an increase in the ovulation rate (not super ovulation) by causing antral follicles from the last two waves of the cycle to ovulate together. This is exciting, as it would allow us to predictably increase the twinning rate in commercial ewes. In this present project we are in the process of replicating this in our University flock using 66 ewes to see if it results in an increased lambing rate. In this trial, ewes have been bred and will lamb in June, 2004. We will than need to see if this works when applied to ewes at any stage of the cycle. If successful, we will run field tests in producer flocks, to see if we can produce a consistent, predictable and manageable increase in lambing rate in commercial ewes.

Improved Fertility to Out of Season Breeding: During the anoestrus or non breeding season, ovulation does not occur in the ewe. Oestrus and ovulation can be induced by using Intravaginal sponges (see above) and injection of Equine Chorionic Gonadotrophin (ECG) at sponge removal. However, fertility to out of season breeding is low. Seasonality of breeding needs to be overcome to guarantee an even flow of fat lamb for marketing. Poor fertility out of season could be due to an unprepared non cycling uterus or lack of proper synchronized ovarian follicle growth. We have tried methods developed in cattle to synchronize follicle growth in anoestrus ewes. We found that injection of the hormone oestradiol (350 mg; IM; in oil) worked in ewes also given intra vaginal sponges. In the present project, we repeated this and added an ECG treatment to induce ovulation. Twelve anoestrus ewes were given MAP sponges for 12 days. Midway through treatment ewes were injected with oestradiol. At sponge removal half of the ewes were given 500 units of ECG (IM). Only the ewes given ECG ovulated. This treatment therefore, holds promise to synchronize follicle growth and ovulation and improve fertility to out of season breeding. Ovarian follicle patterns are currently being summarized on this project and blood samples are being analyzed for reproductive hormone. We now need to apply this on a flock scale and look at fertility. This treatment may also enhance fertility in cyclic ewes and enable us to predict the time of ovulation for A1 and embryo transfer. In the current project we tested this in cyclic ewes. Six ewes were given oestradiol, irrespective of the stage of the oestrous cycle; five ewes served as untreated controls. In the cyclic ewes the oestradiol treatment did not appear to synchronize follicle growth. It is likely that we may need to increase the dose of oestradiol in cyclic ewes or give two injections 12 hours apart. Ovarian follicle patterns are currently being summarized for this project and blood samples are being analyzed for reproductive hormones.

Personnel:

Name

Mr. D. Barrett, Graduate Student
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Mr. R. Duggavathi, Graduate Student
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Other support comes from U of S Scholarships

2. Predicting Age At Puberty And Adult fertility In The Bull By A Simple blood Test In Young Calves

Background, Objectives and Progress: In expanding animal agriculture in Saskatchewan, beef production will be key. The bull will play a central role in an expanding beef industry. In selection for high producing bulls, fertility tends to be sacrificed. Many young bulls are being used in Saskatchewan beef herds and a significant number are slower maturing and of questionable fertility. Within the ADF-SRP in reproduction, we have worked on means to hasten maturation in the beef bull calf and to develop tests in calves to predict age at puberty and fertility in the adult. We believe we have discovered a potentially simple test in young calves to predict age at maturity and hopefully fertility in the adult bull. In general, faster maturing animals are more fertile. This test involves injecting a brain hormone called Gonadotrophin Releasing Hormone (GnRH) and looking at the secretory response of a pituitary hormone called Luteinising Hormone (LH). The LH response at 4 and 20 weeks of age is predictive of the age at puberty. Recently we have injected GnRH into bull calves at 20 weeks of age at various doses and in various sites. We found that 5μg/kg (IM), around the tail head, gave an optimum LH response. In the present project we confirmed that the optimum age for this test was15 and 25 weeks of age and confirmed its ability to predict age at maturity in a larger number of bull calves. This study was initiated last March/April at our University's Goodale farm and involves 43 Hereford bull calves. These animals will be kept until they are 16 months old (July 2004) and will be electroejaculated to check semen characteristics and the ability of our test to predict fertility in the adult bull. In the future, we will move to field tests, in producer herds, to confirm our ability to predict age at puberty and fertility in the adult (semen characteristics).

Personnel:

Name

Mr. Edward Bagu, Graduate Student

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